CPUC Energy Storage Use Case Analysis

Demand Side Management

Storage co-located with EV charging station

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Contents

1. Overview Section

As California supports higher penetration of electrical vehicles (EVs), this will significantly increase load on the grid, and alter power consumption patterns. A typical round-trip work commute of 35 miles per day corresponds to the daily load of an average home (10 kWh). California policies encourage the use of renewable energy sources for EV charging to reduce greenhouse-gas (GHG) emissions and dependency on foreign oil.

There remain many barriers to extensive penetration of EVs, however. On one side, consumers want to save money, to be environmental conscious, and to have a better driving experience. On the other, prospective EV owners exhibit "range anxiety" over how far a vehicle can travel on a single charge; they are concerned that an EV will dramatically impact their electricity bill, and they often read conflicting information about the environmental benefit of EV's compared to hybrid vehicles.

Developing a sustainable infrastructure, including public charging stations, is critical for mass deployment of EVs. It addresses the issue of range anxiety but also provides charging options to the majority of Californians who live in multi-dwelling units and do not have a private garage. To that effect, the California Energy Commission (CEC) has an on-going program to invest in alternative infrastructure.

Each public EV charging station places an added load on the host facility in addition to the local distribution grid. California prefers 24 hour access to public chargers, which means that the charging station host cannot control or predict when a customer charges their vehicle. The EV charging peaks can be costly in the form of demand and delivery charges and eventually discourage the adoption of a public infrastructure.

Therefore, energy storage is a potentially valuable component for the development of EV charging infrastructure. The support for EV customer-side of the meter electricity storage projects has already been demonstrated by the CEC. Energy storage tied to EV charging systems can serve as a complement for other use cases such as energy storage for peak load reduction, load management, demand response and integration of renewable generation.

The Governor has stated a goal of 1.5 million EV's by 2025. A recent study by Pike Research concluded that one of four plug-in EV in the United States will be sold in California from 2012 to 2020.

2. Use Case Description

This Use Case describes energy storage associated with an EV charging station. First, we consider the case where energy storage deployed with a private charging station owned by the same entity that owns the vehicle(s). We refer to this case as "non-aggregated". This can be the case where energy storage is deployed at a residential home with solar PV to offset energy from the grid and provide lower emission electricity to EV's.

Second, we look at the case where the charging stations are open to the public, and EV can connect across locations. We refer to this case as "aggregated" because they are opportunities to aggregate the energy storage at multiple locations open to the public (residential, commercial or municipal) and provide additional services to the grid.

We consider both cases because they cannot be separated from the point of view of the customer who will use both to recharge an EV.

It is assumed that the private and non-aggregated charging stations support a slower level service (SAE level 1 or 2) that can recharge an EV in a few hours at night with Alternative Current (AC). It is assumed that the public and aggregated charging stations support faster charging service (SAE level 2 or 3) that can recharge the EV in 30 minutes or less, but will require higher voltage Direct Current (DC) or three-phase AC.

The nomenclature used here to define "aggregated" and "non-aggregated" services is consistent with the work done by the concurrent Proceeding on Plug-in Electric Vehicles (PEV). Vehicles can serve as storage by performing all the same functional benefits as any other customer side resources (bill management and/or market participation).

For clarity, we focus in this document only stationary energy storage permanently co-located with the charging station on the customer side of the meter. The table below summarizes the different sub-cases for stationary storage co-located with EV charging stations.

	Bill Management Only	**Bill Management and/or Market Participation Grid Services**
Non-aggregated stationary energy storage	See Example 1	See Example 2
Aggregated (multi-sited) stationary energy storage	Not Applicable	See Example 3

2.1 Objectives

Energy storage offers a way to decrease the cost and the pollution of an EV charge by integrating a higher level of renewable energy than the grid. Off-setting energy consumption (in kWh) is the first benefit of storage given the additional of EV charging. This can be done by integrating a local solar roof or a wind turbine collocated with the station.

Energy storage can also play a role in mitigating expensive power peaks (in kW) caused by EV charging on the demand side. To maximize the effectiveness of an EV charging infrastructure, on-site energy storage can prevent those costly peaks and also help to avoid utility infrastructure upgrades associated with additional or excessive loads on-site.

Finally, stationary storage deployed in conjunction with charging stations can act as an “aggregator”. Although, third-party operators are currently not allowed to push energy back on the distribution network, energy storage can provide additional services to the grid (ancillary, etc.). Participation to California ISO markets will be discussed in the cost benefit section.

2.2 Actors

In this Use Case, the storage facility may be operated by 1) the owner of the station or 2) a third party operator. Although utilities are not allowed to own or operate charging stations for now, this could change in the future.

Name	*Role description*
Auto-makers	Manufacture EV’s (charging interface used at stations)
Drivers	Purchaser of EV’s (load profile)
Owner	Owner and possibly operator of charger (responsible for electricity bill)
Supplier	Supplier of energy storage component (batteries or other technology)
Operator	Possible third-party operator (one of network of stations)
Utility	Responsible of distribution network (Demand Response programming, etc.)
ISO	Provide price signals (Demand Response, Ancillary, etc.)

2.3 Regulatory Proceedings and Rules that Govern Procurement Policies and Markets

Agency	*Description*	*Applies to*
CPUC	Self Generation Incentive Program	Owner
CEC	Investment Plan for the Alternative And Renewable Fuel and Vehicle Technology Program,	Owner, operator, Utility
EPA	Fuel Efficiency Standard	Auto Makers, drivers
CPUC	Rule 21 Interconnection Tariff	Operator, Utility
FERC	Order No. 785 Pay for Performance	Operator, ISO

In addition, on May 23, 2012, Governor Brown issued an Executive Order directing the Energy Commission, ARB, and the California Public Utilities Commission to work with the Plug-in Electric Vehicle Collaborative and California Fuel Cell Partnership to develop the infrastructure that will accommodate zero-emission vehicles from 2015 through 2025. Along with the Executive Order, the Governor announced a settlement by the California Public Utilities Commission with NRG Energy, Inc., that will support the further construction of at least 200 fast chargers and a minimum of 10,000 other chargers in at least 1,000.

2.4 Location

The energy storage device is located at the site of the charging station. For at the non-aggregated case, the private station is typically connected to the distribution panel or directly to the solar roof. For the non-aggregated case, public stations along motorways are connected to the distribution network at a retail location (residential, commercial or municipal). It can be close to a transformer or sub-station but it remains on the customer side of the meter. Typically, the energy storage component (batteries or other) is placed on a concrete pad within an enclosure with accessibility to service providers, but generally out of sight of the general public.

Geographic location may prove to be an important factor to evaluate a site for the deployment of a public charging station. Utilities possess hot-spots or pain points in neighborhoods or areas that regularly become overloaded. These areas would be ideal to serve as direct points of demand response in addition to serving as regular local peak mitigation tool. In reverse, the energy storage co-located at the site of the charging station can help with integrating an overload of renewable energy (e.g., solar or wind farm in the distribution network). For clarity, the two benefits above are not included in the cost benefit outside Cal-ISO market mechanisms because they belong to other use cases. However, we recognize that the location of public charging stations will be influenced by those factors in a realistic deployment scenario.

2.5 Operational Requirements

Non-aggregated station requirements

The private station should be able to recharge an EV that has on average today a battery of 20 kWh. We will take this as the size requirement. The battery should be able to support SAE level 1 and 2 so EV can be recharged during a lunch break or overnight.

Characteristic	***Requirements***
Storage capacity	10kWh to 50kWh with 2.5kW to 20kW charge
Size	Size of small appliance like refrigerator to fit in garage
Service	SAE level 1 or 2

Aggregated station requirements

A public station should support multiple EV's recharging during the day. With 30 minutes interval over 10 hours of day-time, it could support as many 20 recharges across various EV's (BEV, PEV, and PHEV). We take an average of 10 kWh, which corresponds to a size of 200 kWh.

The site-specific pre-installation information is critical to maintain successful operations. Information such as the electrical capacity of the facility, the pre-install consumption profile, the number and type of Electric Vehicle Supply Equipment (EVSE) to be installed, the anticipated charge frequency and time-of-day, and perhaps most importantly, the desired peak facility demand are all important to size the system and achieve operational success.Further, a system of monitoring, control and communication must be established. This involves software designed to monitor the system and make decisions in real-time to achieve the desired load balance. Responsiveness and immediate charge and discharge are the keys to operational effectiveness.

Characteristic	***Requirements***
Storage capacity	50 to 200 kWh per station with 20kW to 100kW charge

Characteristic	*Requirements*
Size	Size of gas pump
Service	Fast charging service. SAE level 3 is under work. Available today: CHAdeMO (Japan), HPC (Tesla), and Combo Charger

2.6 Applicable Storage Technologies

The potential storage device that appears most applicable to this Use Case in a home environment is some form of battery that can deliver electricity quickly with a minimal footprint. Commercially viable batteries of this scale include Sodium Sulfur (NAS) and Lithium Ion (Li-Ion).

Batteries are also good candidates for public charging stations. However, other technologies could be deployed to fit in underground spaces (like it is the case for gasoline today). Compressed air storage (CAES) facility could also provide the right combination of response rate and rated power, but is not as widely available as batteries at this scale. There is also an increase in the development of new flow-batteries that may come into the market place in a few years.

Capacitors do not support the capacity requirements for such large stationery applications. However, they can be used in tandem with batteries to mitigate spike charges.

Storage Type	*Storage capacity*	*Discharge Characteristics*
Li-Ion batteries	10 kWh to 250kWh	Fast response, short to medium duration
NaS batteries	100kWh to 1MWh	Medium response, medium duration
CAES		

2.7 Non-Stationary Storage Options for Addressing this Objective

Alternatives include:

- Using the energy storage element in the EV's (batteries) to provide control charging and discharging services. However, the energy storage is not permanently co-located with the charging station and must be managed.
- Installing EVSE's without energy storage, and paying the associated peak demand charges that result
- Limit the times when customers can charge their EV's to the valleys of the facility's consumption pattern (private or public facility).
- Pay for upgrades to distribution network to allow for electrical capacity to support desired number of EV charging stations
- Charge vehicles off renewables when the system is generating

3. Cost/Benefit Analysis

3.1 Direct Benefits

End Use	*Primary/ Secondary*	*Benefits/Comments*
1. Frequency regulation	S	Aggregated ancillary
2. Spin		
3. Ramp		
4. Black start		
5. Real-time energy balancing	P	
6. Energy arbitrage	S	
7. Resource Adequacy		
8. VER[1] / wind ramp/volt support,		
9. VER/ PV shifting, Voltage sag, rapid demand support	S	
10. Supply firming	S	When energy storage is deployed with solar or wind
11. Peak shaving: load shift	P	
12. Transmission peak capacity support (deferral)		
13. Transmission operation (short duration performance, inertia, system reliability)		
14. Transmission congestion relief		
15. Distribution peak capacity support (deferral)	P	
16. Distribution operation (volt/VAR support)		
17. Outage mitigation: microgrid	S	
18. TOU energy mgt	P	
19. Power quality	S	
20. Back-up power	S	

[1] VER = Variable Energy Resource

3.2 Other Beneficial Attributes

Benefit Stream	*Y/N*	*Assumptions*
Reduced Fossil Fuel Use	Y	Reduction in fossil use is linked to higher penetration of EV's as well as higher integration of renewable energies (e.g., solar) at the premise of the charging station.with reduction in GHG emissions.
Increased Transmission Utilization	N	
Power Factor Correction	Y	EVSE can provide power factor correction where it is needed most – at or near the load. The value of this power factor correction should be compared to other methods of distributed power factor correction.
Over generation management Increased use of renewables to meet RPS goals	Y	At times of over generation, energy storage can help to avoid uneconomic curtailment of RPS and conventional resources.
Faster regulation	Y	Some technologies can respond faster and provide a higher amount of benefit to the system for frequency regulation.
Faster build time	Y	Customer or third-party-owned storage can reduce the need for utilities to procure traditional assets when more charging stations are deployed and putting pressure on the grid.
Locational flexibility	Y	The storage device or aggregated devices can be situated where they provide highest value.
Size flexibility - Modularity	Y	EVSE can accommodate a wide variety of aggregated system sizes. In many instances, smaller amounts of storage may be able to eliminate the need for a traditional fossil generator. The value of these resources can thus be greater than the traditional per-MW value of a resource.
Optionality	Y	Energy storage can be deployed as an option with charging stations. Also they can act in complement to the batteries in the EV's already.
Multi-site aggregation	Y	Aggregated distributed devices are less likely to fail simultaneously, providing a reduced risk to utilities. This also provides a more uniform services to EV drivers
Grid/communications reliability	Y	EVSE's can be used to keep up EV charging service during grid black-outs

3.3 Analysis of Costs

Cost Type	*Description*
Energy storage element	Cost is approximately \$500-\$1200/kWh but can vary significantly on technology used
Installation	Cost to get permit to install station is significant for home installations (about \$2,000). For public installations, infrastructure work requires significant planning with local authorities and utilities
O&M	The addition of an energy storage gives the ability to control the

Cost Type	*Description*
	stations remotely (smart systems) and should minimize O&M costs as a result compared to gas stations that require to continuously refill the tanks with truck rolls

3.4 Cost-effectiveness Considerations

Cost effectiveness is contingent on a number of factors:

- Host facility load patterns
- Frequency and duration of the EV charging
- Quantity of EVSEs
- Size requirement for battery
- Presence of other on-site distributed generation

The installation of energy storage at charging stations provides a financial benefit through two primary mechanisms

1). Cost avoidance: this is achieved by reducing and managing the load on the distribution grid. This includes energy off-sets (in kWh) and peak avoidance (kW)

2). New revenues: this could be achieved by letting the energy storage element at EV charging stations to participate in a number of markets (Demand Response, Ancillary, etc.). This is not possible today due to Rule 21 but this could change.

4. Barriers Analysis and Policy Options

The main barrier today is cost of batteries. Prices of batteries are coming down significantly now with the deployment of EVs, and other technologies like CAES could make energy storage installations even more attractive. In particular, home owners and operators of public charging stations are sensitive to the pay-back period of their investment.

Upfront cost of equipment and installation will continue to be barrier to full commercialization. However, the peak-mitigation benefit provided by the storage could allow for a faster payback beyond revenue from charging, and alleviate the pain-points that typically cause public charging hosts to pull chargers out of the ground.

Allowing third-party operators to participate in ISO markets would make the business case more attractive as it provides additional revenues.

4.1 Barriers Resolution

Barriers Identified	*Relevant Y/N*	**Policy Options / Comments**
System Need	Yes	*What is the barrier?* There is not clarity around the future needs and attributes for the California system to maintain reliability with 33% renewables. As a result, it is not known what attributes are needed to manage the future system. Demand side resources need to be taken into account *How is it a barrier?* LSEs cannot send definitive signals on their future procurement needs. *What are the potential resolutions?* Evaluate system needs holistically and look into areas where demand side resources provide cost effective solutions to long term system needs.

Barriers Identified	*Relevant Y/N*	**Policy Options / Comments**
		An alternate option is to rely on the LTPP to solely determine the future system needs and attributes for meeting that need. The LTPP would also provide the authorization for the CPUC jurisdictional utilities to engage in procurement. The storage OIR can ensure that CAISO modeling and CPUC LTPP do not bias against demand side storage participating to address future needs.
Cohesive Regulatory Framework	Yes	*What is the barrier?* Existing regulatory framework does not consider demand side resources for meeting generation or transmission identified needs. To the extent transmission is a rate based asset, it is considered differently than non-rate-based resources like energy storage. *How is it a barrier?* Storage can be used to reduce the amount of transmission infrastructure needed in the system. There is a regulatory and decision making gap between the FERC, CPUC, and CAISO's transmission planning processes. *What are the potential resolutions?* System planning should adequately consider customer sited storage may have a role to play in alleviating needs in the bulk transmission system, including transmission needs, thus demand side resources should be considered in planning processes that have historically not included demand side resources. Expanded planning processes must treat resources fairly.
Evolving Markets – A/S	Yes	*What is the barrier?* The future A/S products are not defined yet. Behind the meter utility owned/operated systems have not been clearly defined. Behind the meter A/S participation has also not been clearly defined. *How is it a barrier?* Without clearly defined market and ownership rules, it is difficult to finance and develop energy storage systems. *What are the potential resolutions?* The CAISO is in the process of implementing pay for performance regulation, regulation energy management for sub 1-hour resources, updated market models to allow selling ancillary services during charging, and flexible ramping product. CPUC might consider a policy to allow utility ownership and/or operation of behind the meter assets. It may make sense to pay directly for value provided to the grid by a customer-sited storage device under a certain operating scenario.
Evolving Markets – RFO Process	Yes	*What is the barrier?* Current utility RFOs do not allow for aggregated DESS to bid on wholesale bids. *How is it a barrier?* DESS can provide benefits to the utility customers as well as the distribution and transmission system. Currently, it is not possible to bid into traditional utility procurement, which limits DESS adoption. *What are the potential resolutions?*

Barriers Identified	*Relevant Y/N*	**Policy Options / Comments**
		RFOs should allow for distributed and/or utility controlled BTM systems, and correctly evaluate the value of BTM systems.
Resource Adequacy Value	Yes	*What is the barrier?* There are no clear rules for the RA credit that customer sited energy storage can count for. There is no long term procurement under RA. *How is it a barrier?* Energy storage provides capacity that is flexible. The current RA rules do not differentiate between flexible RA and non-flexible RA. To maximize the value of storage, long term procurement is needed. *What are the potential resolutions?* The RA proceeding will establish RA rules for energy storage and is investigating having differentiated RA products, including flexible RA. It is not clear if this will be a large enough incentive to help make energy storage cost-effective. Storage isn't defined for resource adequacy.
Cost Effectiveness Analysis	Yes	Cost effectiveness should focus on creating a framework that defines what the sources of value are and the beneficiaries.
Cost Recovery Policies	Yes	*What is the barrier?* Cost recovery policies for customer sited systems are undefined. Multiple cost recovery policies might be necessary to address all potential uses of energy storage. Lack of revenue predictability for non-rate-based assets make financing and/or selling projects difficult. *How is it a barrier?* Products that storage provides, such as A/S are not procured on a forward basis through long-term contracts *What are the potential resolutions?* A wide range of cost recovery policies need to be evaluated and implemented as appropriate. Need ability to secure long-term (greater than 10 years) contracts with guaranteed revenue for that duration. That will help unlock project funding for deployment of storage. There could be an ability to get long term, guaranteed revenue contracts for the financial life of storage projects when they are deployed for ramping services, frequency regulation, RA and other services.
Cost Transparency & Price Signals	Yes	*What is the barrier?* Lack of consistent of electricity tariffs make financing DESS projects difficult. *How is it a barrier?* Bill Management customers need to have predictable tariffs in order to invest in storage. Three different utilities have different tariffs, which can make project development more complex. *What are the potential resolutions?* Create storage-specific predictable tariff structures which properly compensate customers for value provided by storage devices.
Commercial Operating Experience	Yes	*What is the barrier?* Many technologies do not have sufficient operating experience to reduce costs and promote investment by utilities. *How is it a barrier?*

Barriers Identified	*Relevant Y/N*	Policy Options / Comments
		New technologies find it difficult to compete with incumbent technologies that have less technology risk. *What are the potential resolutions?* Incentivize field demonstration. Help to define path to commercialization. There is no widely accepted standard for fast charging stations (level 3). For slower stations at private locations, SAE level 1 and level 2 are recognized internationally.
Interconnection Processes	Yes	*What is the barrier?* Complex and expensive interconnection rules for behind the meter systems of all types. For systems managed by utilities, aggregated systems, and/or systems participating in CAISO A/S markets, there are additional issues that need to be resolved. *How is it a barrier?* The interconnection process and rules are prohibitively expensive and time consuming for DESS. *What are the potential resolutions?* Comprehensive solution that fixes Net Energy Metering and Rule 21. Create an interconnection fast track for certain types of storage paired with renewables. Revise interconnection rules and requirements for aggregated DESS systems participating in A/S and/or providing grid operation benefits under utility control.
Optionality Value	Yes	*Please see optionality clarification document*

4.2 Other Considerations

It is important to note that consumers purchase cars for aesthetic reasons as well. Over investments in energy storage would not necessarily lead to higher adoption of EV's. Rather, energy storage can be used as a flexible tool to provide a consistent EV offering to end-consumers: the ability to recharge an EV at a predictable cost with significantly less emission than gasoline cars. Drivers of combustion vehicles have been hit by rising gas prices. Today, there are few EV drivers on the road and they benefit from free public charging stations and prime parking spots. As the number of EV's increase, this situation will change and EV drivers are exposed to congestion at charging stations and may be charged very different prices across California. If not addressed, this would likely slow down massive adoption of EV's.

5. Real World Examples

We look at three real-world examples: two at consumer premises (private charging stations) and two along motorways (public charging stations).

5.1 Example 1: Non-aggregated station for fleet of vehicles at manufacturing site (Ford, Michigan)

Project Description

Ford has teamed up with DTE Energy, Xtreme Power and the state of Michigan to establish one of the largest solar power generation systems in Michigan at Ford's Assembly plant. The energy storage component consists of a 750 kW system from Xtreme Power with 2MWh of energy storage. The technology is lead acid battery. In addition Ford will explore using 50kWH of re-used EV batteries (Lithium-Ion) as a second-life application.

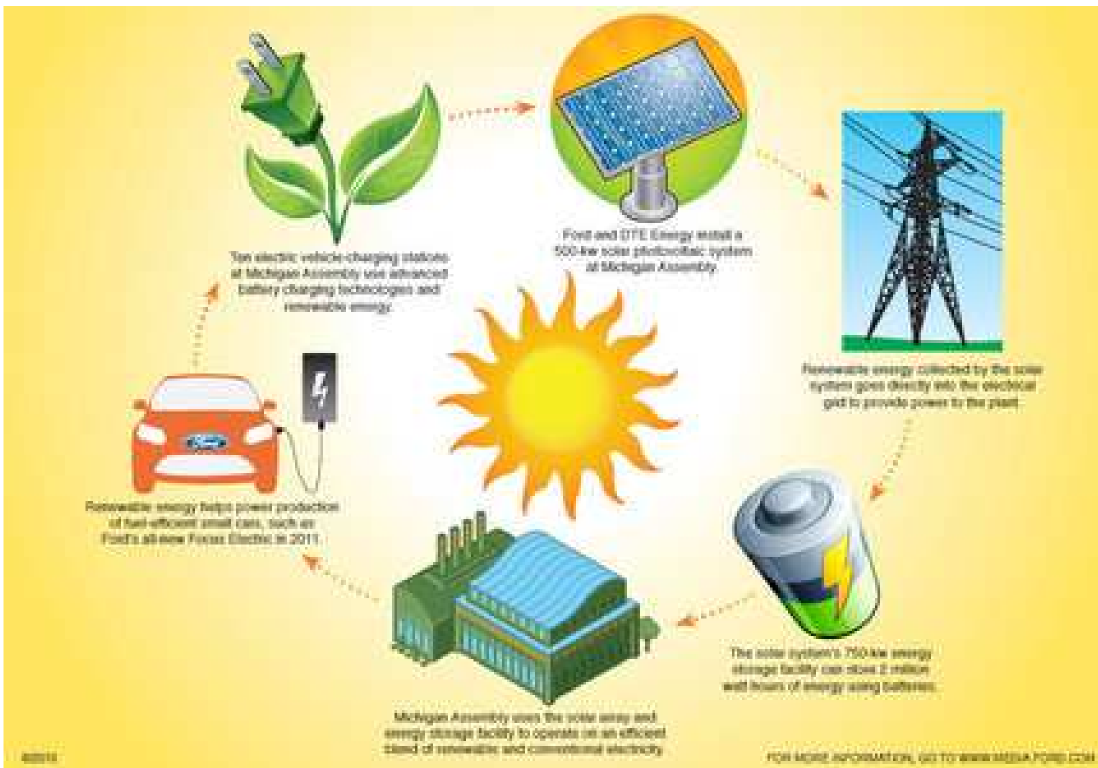

Figure 1 – Courtesy of Ford

Energy storage will be used to power the plant with a mix renewable and conventional energy. The renewable energy collected by the solar system will go directly into the energy-efficient microgrid to help provide power to the plant. When the plant is inactive, such as holidays, the collected solar energy will go into the energy storage system for later use, providing power during periods of insufficient or inconsistent sunlight. Michigan Assembly's energy storage system will be able to recharge from the grid during offpeak hours when energy is available at a lower cost. This in turn will provide inexpensive power during peak operating hours when the cost per kilowatt-hour is higher, and reduce peak demand on the grid.

In addition, it will power ten EV charging stations with 100% renewable energy at the plant. The stations will be used to recharge electric switcher trucks that transport parts between adjacent facilities. Xtreme Power will provide an active power management system on the charging stations.

Location	Ford Motor Company, Michigan
Operational Status	Project launched in 2010 and completed in 2011
Ownership	Ford
Primary Benefit Streams	Integration of solar farm and load shifting
Secondary Benefits	Reduce Emissions
Available Cost Information	

5.2 Outstanding Issues

Description	*Source*
Use of second-life EV batteries for battery storage	

Contact/Reference Materials

The source of the information in the example comes from the press release by Ford: http://www.xtremepower.com/downloads/pressreleases/100812-Ford-Press-Release.pdf

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5.3 Example 2: Non-aggregated station at commercial store (7-Eleven, NY)

Project Description

Green Charge Networks' GreenStation operating at a 7-Eleven location in Queens, NY. Energy storage is particularly useful to mitigate peaks due to higher current when EV's are charged. The plot below at the 7-Eleven store un New York State (courtesy of Green Charge Networks) shows how peak demand can be reduced significantly (1st plot) despite Level-2 chargers thanks to energy stored on demand (2nd plot). Power spikes would be more pronounced for DC chargers.

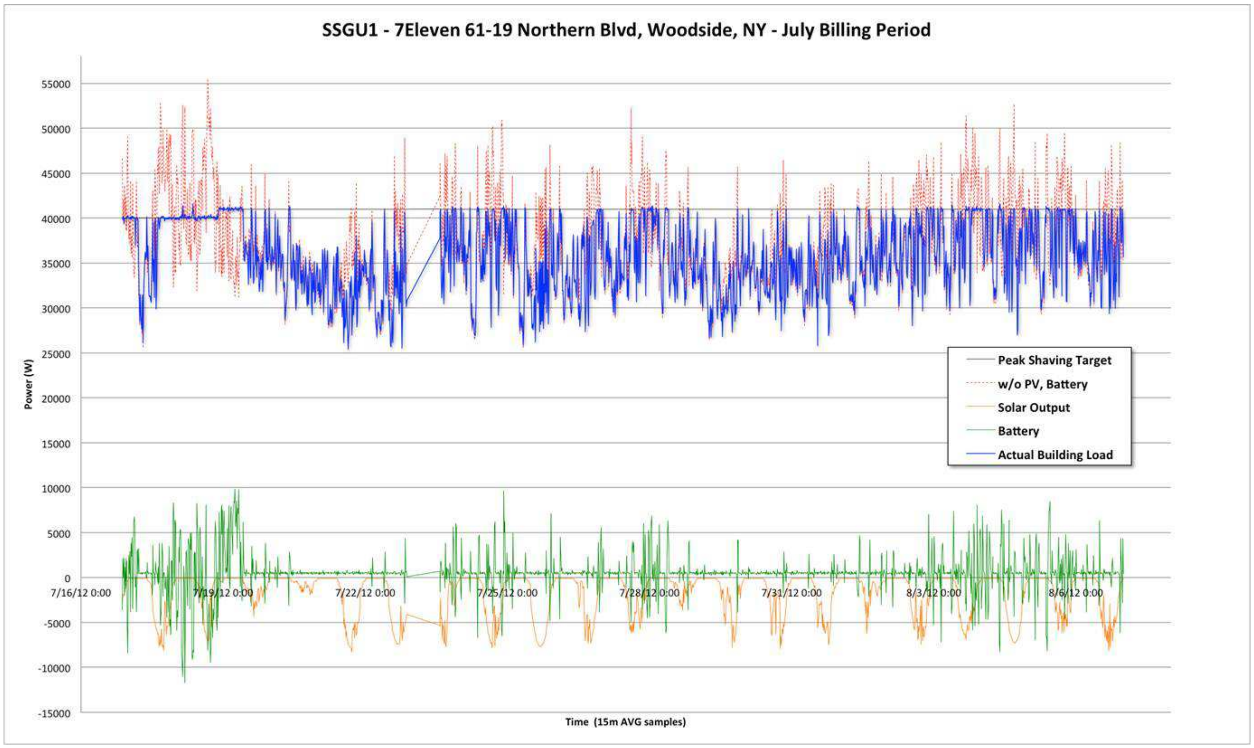

Figure 2 – Courtesy of Green Charge Networks

In addition to daily load control, the GreenStation can act as an ever-ready demand response volunteer by providing an immediate response to hotspots on the local distribution grid. Instead of a blanket demand response signal, which may or may not alleviate the problem areas, a utility can now call out to reliable field assets in areas where relief is needed most, in exchange for a payment to the system owner.

Location	*7-Eleven convenience store, Queens, NY*
Operational Status	Fully Operational as of Summer 2012 with 96 kWh of Li Ion battery storage
Ownership	Operator-owned
Primary Benefit Streams	Peak Demand Mitigation, Demand Charge Avoidance, Infrastructure Upgrades Avoided, Energy Arbitrage , Fast EV Charging Revenue
Secondary Benefits	Demand Response Revenue
Available Cost Information	DOE supported demonstration

5.4 Outstanding Issues

Description	*Source*
High Cost of Batteries	
Customer Identification	

Contact/Reference Materials

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5.5 Example 3: Aggregated stations on Island of La Reunion (France)

Project Description

The French island of La Reunion has the highest level of solar in its energy mix (30% at peak, 5% on average). The recent decrease in feed-in-tariffs and the emergence of EV's has led the local actors (solar integrators, car dealership, energy operator, etc.) to look at deploying a network of 50 charging stations power by solar.

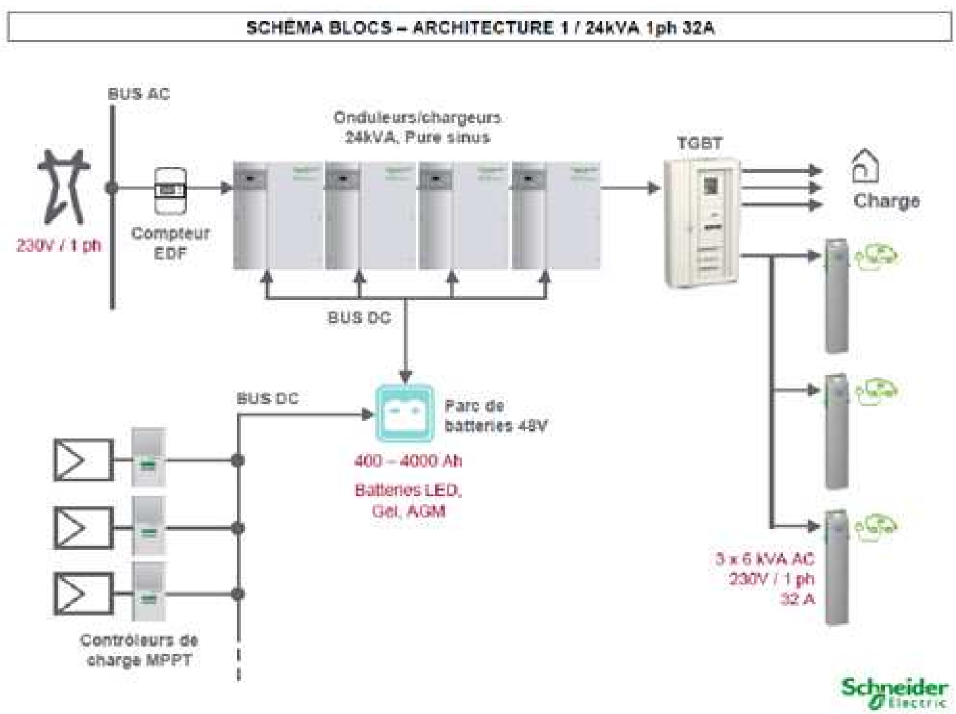

Figure 3 – Courtesy of Schneider Electric

The charging station functions at 32 Amps and 230V – single phase. The 48V batteries are connected to the grid via an AC-to-DC converter and solar installations. Each battery module supports 19.2 kWh (400Ah at 48V) and one station can host up to 10 modules for a total capacity of 192 kWh per station.

The team deploying the 50-station pilot consists of: Renault (EV maker), EDF (utility), le Groupe

Bernard Hayot (car dealership), Total (energy giant), Tenesol/Sunzil (solar integrator), Schneider Electric (equipment manufacturers), GE and ADAMELEC. The main goal is to reduce emissions in a region where the energy mix comes from fossil fuels at 67%.

The project will also study the demand profile and optimize the dimensioning of the different parts of the architecture to deliver the best service to consumers. In particular, the project will aim to demonstrate a mobile charging offering on the island across 50 stations.

Location	Island of La Reunion, France
Operational Status	Pilot on 50 stations
Ownership	EDF
Primary Benefit Streams	Reduce Emissions
Secondary Benefits	Mobility of offering across multiple stations
Available Cost Information	

5.6 Outstanding Issues

Description	*Source*
Cost of batteries	Not available

Contact/Reference Materials

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6. Conclusion and Recommendations

We looked at both aggregated and non-aggregated charging stations. Energy storage can play a significant role in supporting the adoption of EV's and it provides financial benefits to owners of energy storage deployed in conjunction with charging stations. Energy storage could also provide additional benefits to the grid. As a result, energy storage could provide a stronger financial return if charging stations with energy storage could participate to California ISO markets (Demand Response, Ancillary, etc.).

In order to affect the loads created by EV charging, storage is a key component. It will only be through the coordination with utilities on issues such as interconnection, back-feeding, and aggregation that this use case can scale and will likely succeed. Energy and power efficiencies can prove beneficial across the board to EV drivers, station owners and utilities, provided that coordination takes place and barriers are removed.

Given the size requirement to participate in California ISO markets (e.g, 500kW) public stations are particularly attractive to provide an aggregation function across brands of charging stations and vehicle manufacturers. This would result in more predictable charging costs to consumers as well as better consumer experience. Currently, EV drivers often have multiple network cards and will start to suffer charging fees at public stations. As the number of EV's increase, this could prevent massive adoption of EV's in California where drivers have the alternative to choose fuel efficient vehicles.

The following Q&A provides itemized conclusions and recommendations to CPUC.

Is Energy Storage commercially ready to meet this use?
Yes, In particular there is a synergy between batteries in EV's and at stationary locations. The cost reduction in batteries makes it easier to invest in energy storage.

Is Energy Storage operationally viable for this use?
Yes. Multiple pilot projects have been demonstrated in private and public locations

What are the non-conventional benefits of storage in this use?
It supports the growth of a complementary industry (EV) and it reduces green-house-gas emissions.

Can these benefits be monetized through existing mechanisms?
Yes, based upon electricity rates schedules, demand charges, and demand response program structures.

If not, how should they be valued?

Is ES cost-effective for this use?
Yes but a case by case basis

What are the most important barriers preventing or slowing deployment of ES in this use?
The problem of demand charges associated with Fast Charging is not fully realized by the market. The solution is in the works, but not easily achieved, as site specific engineering and installation can be expensive and software and monitoring technology is only now being developed. From a regulatory perspective, Rule 21 currently prevents operators of charging stations with energy storage to export. This makes the use case less cost effective.

What policy options should be pursued to address the identified barriers?
The deployment of smaller energy storage elements (10-50 kWh) at private premises makes particular sense in conjunction with non-aggregated charging stations. As the cost of energy storage will continue to decrease, utilities will receive more SGIP applications. Like for solar in the past, it is pertinent to discuss whether SGIP can scale to support the deployment of EV's. The Energy Storage (AB 2514) could facilitate the procurement of energy storage by end-consumers so the amount of distributed storage

increases as the number of EV's increases. This would alleviate the additional load on the grid that has shown difficulty to integrate intermittent sources (solar and wind) and will likely struggle to support intermittent loads (pockets of high-penetration of EV's).

The deployment of larger energy storage elements (50-250 kWh) at aggregated charging stations is more complicated but can offer additional benefits to overall eco-system. Rule 21 currently prevents third-party aggregators to benefit from additional revenue streams by making electricity available to the grid based on market price signals. This should be discussed as well as the role of the local utility.

Should procurement target or other policies to encourage ES deployment be considered for this use?

Procurement could be encouraged for owners of homes and business locations to support the additional load of EV's in California (1.5 million EV's by 2025).